To overcome this problem, in the present invention, processing apparatuses are provided which are equivalent to the processing stations of the related art, but which are provided with a wafer insertion portion. An exchange element is also provided on a mobile element movable between the wafer processing apparatuses. The exchange element is capable of holding and transporting one or more wafers at a time. Wafers to be processed are placed in a wafer insertion portion of a first wafer processing apparatus, and then loaded into the apparatus for processing. Once processed, they are unloaded from the apparatus into the wafer insertion portion for removal by the exchange element. In this way a wait time of a wafer between apparatuses during processing is minimized. The same sequence of operations is carried out for each processing step at each apparatus.

Thus, the present invention is particularly well suited to processing wafers in relatively small numbers at a time, since one or more wafers are removed from a wafer insertion portion of a wafer processing apparatuses at a time for transport to a subsequent wafer processing apparatus. Since, at a maximum, only a few wafers at a time are loaded, unloaded or transported, a wait time of wafers between processing apparatuses and concomitant risk of contamination, are minimized.

Turning to the citations. All of the claims are rejected as being obvious over WO98/19333 in view of Hansen et al. and Miller.

However, WO98/19333 is directed to a single wafer processing station or apparatus in a wafer processing line, not a plurality. Thus, the wafer processing station 1 in WO98/19333 in no way teaches the conveyance system in the present invention. As shown in Fig. 1 of W098/19333, the wafer insertion portion is comprised of a case for storing and loading and unloading wafers. In contrast, the wafer insertion portion in the present invention is not used for storage, and the invention is not directed to the mass processing of like wafers,

While Hansen et al. teach a conveyance system, the invention is directed to a wafer processing station of the kind disclosed in WO98/19333. Namely, in Hansen et al., in the wafer processing station 10, the interface section 12, which is equivalent to a wafer insertion portion, as is disclosed in the specification and shown in Figs. 3-8, is designed to accommodate a large number of processed wafers during batch processing.

With respect to Miller, there is no teaching of the conveyance system of the present invention. Further, the wafer transporter 26 of Miller does not include the exchange element of the present invention.

In summary, while discrete features are disclosed in the references which could be construed as having equivalency to features disclosed in the present application, these features when taken either alone or in combination, in no way teach the main and novel feature of the present invention, which is directed to: reducing a wafer wait time between processing apparatuses; reducing a risk of contamination; and to enabling both relatively small numbers of wafers and single wafers, to be processed efficiently at a time.

Respectfully submitted,

Dated: November 5, 2001

Tadashi Horie
Registration No. 40,437
Attorney for Applicants

BRINKS HOFER GILSON & LIONE
P.O. BOX 10395
CHICAGO, IL 60610
(312)321-4200

APPENDIX 1

1. A wafer conveyance system [A conveyance system for conveying one or more wafers between a plurality of wafer processing apparatus having a wafer exchange position], comprising:

a plurality of wafer processing apparatuses each having an insertion portion;

a guide path defined along [rail provided between said wafer exchange position of] said plurality of wafer processing apparatuses;

a mobile element movable [provided so as to be capable of moving] along said guide path [rail]; and

a wafer exchange element provided on said mobile element, and capable of [holding a wafer at a time] removing one or more processed wafers from said insertion portion of one said wafer processing apparatuses, of holding and transporting said one or more wafers, and transferring said one or more wafers to said insertion portion of another wafer processing apparatus [exchanging a wafer at a time with other apparatus capable of exchanging a wafer;]

[wherein a wafer is received from one of the wafer processing apparatus by said wafer exchange element, the wafer processed by said wafer processing apparatus is held by said wafer exchange element, said mobile element moves to said wafer exchange position of a wafer processing apparatus to perform a next process on the held processed wafer, and the wafer held by said wafer exchange element is transferred to the wafer processing apparatus to perform the next process].

Appendix 2

3. A conveyance system in accordance with claim 1, wherein said guide path [rail] comprises a first magnetic field generating element for generating a magnetic field; and said mobile element comprises a second magnetic field generating element for generating a magnetic field, forming a linear motor in conjunction with said first magnetic field generating element, and conferring a propulsive force to said mobile element.

Appendix 3

4. A conveyance system in accordance with claim 2, further comprising a power supply element provided along said guide path [rail]; wherein an electric power is supplied to said mobile element by means of said power supply element.

Appendix 4

5. A conveyance system in accordance with claim 4, wherein said power supply element comprises a lain electric cable or electric coil provided along said guide path [rail]; and an electricity receiving element provided on said mobile element for receiving the electric power supplied to said electric cable or electric coil without contact, whereby electric power is supplied to said mobile element without contact.

7. A conveyance system in accordance with claim 6, wherein said control element supplies electrical signals containing control data to the electric cable or electric coil provided along said guide path [rail]; and said communication element receives the electrical signals containing control data supplied to said electric cable or electric coil by means of said control element.

Appendix 6

8. A conveyance system in accordance with claim 6, wherein said communication element is an optical communication element, a radio communication element or a cable communication element provided alongside of said guide path [rail].

Appendix 7

10. A conveyance system in accordance with claim 6, further comprising a position detecting element for detecting a position of said mobile element moving along side said guide path [rail]; and said control element generates control data based on detection results of said position detecting element and wafer conveyance requests from said wafer processing apparatus.

Appendix 8

11. A conveyance system in accordance with claim 6, further comprising position detecting element for detecting a position of said mobile element moving along said guide path [rail]; and said mobile element control unit controls the operations of said mobile element based on detection results of said position detecting element and control the data supplied from said control element through said communication element.

Appendix 9

12. A conveyance system in accordance with claim 10, wherein said position detecting element comprises a plurality of mobile element detecting sensors placed [arranged] along said guide path [rail], and said mobile element detecting sensors are placed [arranged] at [a] regular distance intervals [spacing] throughout the guide path or placed at narrower intervals near [, or are provided more densely at positions closer to said wafer exchange positions of said] the wafer processing apparatuses than along midways between adjacent two wafer processing apparatuses.

Appendix 10

13. A conveyance system in accordance with claim 1, further comprising a space forming element for forming a closed [partitioned] space such as to enclose [cover] said guide path [rail and a path of movement of] inside which said mobile element moves [moving] along said guide path [rail]; wherein the of air purity inside said closed [partitioned] space formed by said space forming means is higher than the degree of purity outside said space.